

## **EXHIBIT 7**

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# **Response to CTIA RFI on Wireless Number Portability**

**Lucent Technologies**  
Bell Labs Innovations



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### **Abstract:**

There are two possible options for wireless local number portability. The first option (OPTION-1) is to port both the Mobile Station Identification (MIN) and the Directory Number (DN). The second option (OPTION-2) is to port just the Directory Number (Mobile Station Identification is NOT ported). Both options and their implications are addressed in this response. This response also addresses the open issues that need to be resolved to meet the FCC's deadline on wireless local number portability.

### **I. Introduction:**

The Telecommunication Act of 1996 requires Number Portability as a minimum requirement in opening the local exchange market to competition. Number Portability gives the subscriber the ability to retain their Directory Number even when they move from one carrier to another carrier. Number Portability can be grouped into three categories - Service Provider Portability, Service Portability and Location Portability.

1. **Service Provider Portability:** Allows subscriber to retain the Directory Number after changing service provider.
2. **Service Portability:** Allows subscriber to retain the Directory Number after changing services like from POTS to ISDN.
3. **Location Portability:** Allows subscriber to retain Directory Number after changing the physical location. LNP Location Portability addresses the movement of subscriber beyond the rate center boundary.



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FCC's order stipulates the following deadlines for CMRS carriers:

1. **December 31, 1998** to deliver calls to ported numbers nationally.
2. **June 30, 1999** for full number portability for CMRS carriers including roaming.

FCC's order does not require service portability and location portability at this time.

### **I.I Wireless LNP :**

The mobility of wireless subscribers adds complexity to the wireless number portability scenarios compared to landline number portability scenarios. For registration and call delivery we need to know the home location register (HLR) address of the mobile. The method that will be used to identify the home location register will depend on the number portability solution used by the industry.

#### **Mobile Identification Schemes:**

The following Mobile Identification Schemes are used:

##### **MIN (Mobile Identification Number):**

A 10 digit mobile identification number known as MIN is used as identity of mobiles to all air interface standards published before 1994. The MIN a NANP number or a non-NANP number. The NANP mobiles are those whose home system is within the NANP



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(North American Number Plan). Non-NANP mobiles are those whose home system is external to NANP. The NANP mobiles use NPA-NXX-XXXX format for MIN. The Non-NANP mobiles use MCC-MNC-MSIN format for MIN.

### **E.212 IMSI (International Mobile Station Identity):**

E.212 is ITU recommended number for identification of mobiles world wide. This number may be up to 15 digits.

### **MIN based IMSI:**

Some systems use MIN based IMSI. This scheme uses the 3 digits of Mobile Country Code, followed by 2 digits and followed by 10 digit MIN.

### **I.II Assumptions:**

1. To be consistent with the predominant landline number portability solution, the Location Routing Number (LRN) method is assumed as the method for wireless number portability in this response.
2. Since it has not yet been determined whether to port the mobile station identification number or not, in this response we have provided two options. The first option assumes that both mobile station identification (MSID) and directory number(DN) are ported and the second option assumes that only directory number (DN) is ported. In this document, OPTION -1 refers to porting both MIN and DN and OPTION - 2 refers to porting just the DN. There are some advantages and some disadvantages to



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both the options and these are listed at the end of the response. The option that Lucent Technologies will support depends on which option the industry wants.

3. In this document mobile identification number (MIN) is used as the primary identification of mobiles. The solution could be applied without further modification for international mobile station identification (IMSI). IS-41C supports MIN and does not support 15 digit E.212 IMSIs. Full IMSI support being included in IS-41D.
4. Primary focus of this response is about the number portability architecture and operation. This response does not cover the aspects of administration of MIN, LNP-SCP database, MIN to HLR translations and other subscriber information maintenance using Service Management System (SMS).
5. It is assumed that the LNP-SCP query is done at the first possible exchange as it will be efficient with respect to trunking, if location portability is implemented in the future. The solutions provided in this response could be applied to other options of LNP-SCP query.



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**II Response: OPTION-1**

The section numbers provided in the CTIA RFI has been maintained in this document for easy reference.



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### **Section 5.1: Proposed Architecture overview:**

#### **OPTION-1: In this option both MIN and DN will be ported.**

Figure 1-1, Figure 1-2, Figure 1-3, and Figure 1-4 provides an overview of this option.

Since both MIN and DN are ported, we cannot use 6 digit translation on the MIN for identifying the home location register of the mobile. We need a 10 digit Global Title Translation (GTT) for identifying the home location register. So the STPs in the network should be capable of 10 digit GTT or there will be a need to have a database mapping MIN to HLR address.

#### **Network elements:**

**Does the architecture use any one or a combination of the following: STP, SCP, ISCP, IP, MSC, etc. If so, what information and process needs to be available at each element? Is more than one database required?**

Beside the normal wireless network elements, this option requires STPs capable of 10 digit GTT or a database for mapping MIN to HLR address (this could be part of LNP-SCP database), LNP-SCP for mapping ported directory number to LRN. The HLR could be either an integrated HLR or a stand-alone HLR. The LNP-SCP could be part of a WSCP. The network elements and their functionality are explained in the various call scenarios provided later. The basic elements of the network are provided in the following diagram:



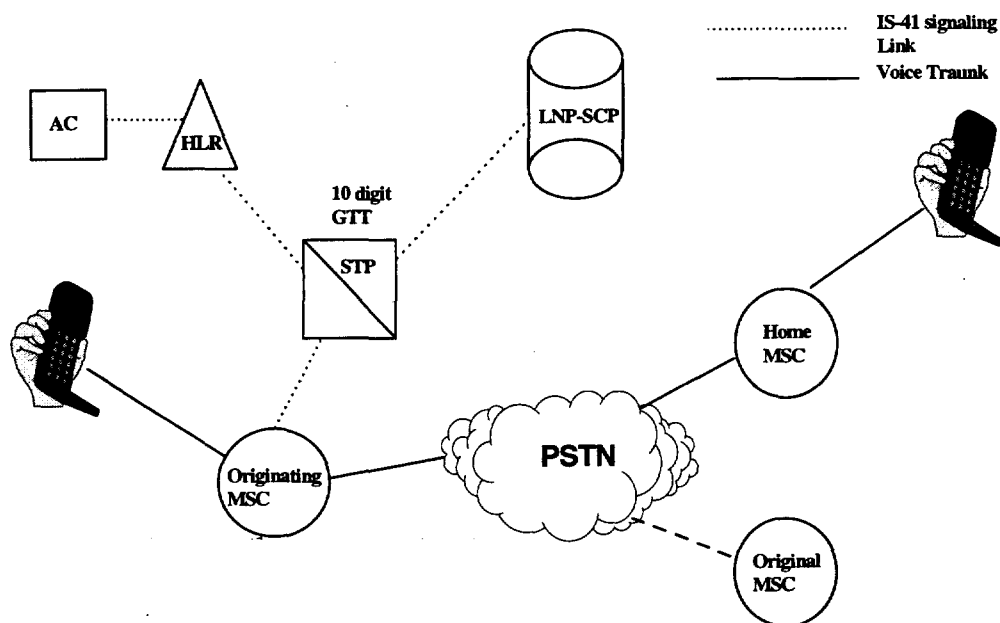


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Figure 1-1

# LNP - OPTION - 1

## BASIC NETWORK ELEMENTS



The above architecture assumes that the STP is capable of translating 10 digit MIN to HLR address. If that is not supported, then there will be a need for a database query for MIN-HLR translation. This information could reside in the LNP-SCP database.

### Triggering:

Identify any trigger mechanisms and protocols used, and at which points in the network for this architecture? (ITU IN CS 1R, ANSI IN, AIN, WIN?)

The triggering in the mobile switching center is assumed to be the WIN based dialed number trigger. The existing IS-41C OriginationRequest message would be used to



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query the LNP-SCP database for mapping the called DN to the LRN. The LNP-SCP database should support IS-41C querying capability.

If STP does not provide 10 digit translation for MIN to HLR, there will a need for new trigger at the mobile switching center for querying the MIN-HLR database.

**Gateway Requirements:**

**Are there requirements for a new gateway function for wireless networks?**

No new gateway functions for wireless networks is assumed in this response.

**Network Routing Number Entity:**

**Under LRN process to which network element does the network routing number point? (MSC-Home, HLR, MSC-Gateway, Mobile network gateway)**

In this architecture, it is assumed that the LRN provided by the LNP-SCP is the network address of the MSC-HOME.

**Central database:**

**Is a central database for wireless use required for identification of HLRs or are there other methods available?**

If the STP could do 10 digit translations, then MIN to HLR translation could be done by the STP. If not, there is a need to support a database for MIN-HLR translation. This could be a central database or it could a distributed database. In both cases, updates on MIN-HLR translation have to be well coordinated.

**SS7 Global Titles:**



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**Identify any impacts on current SS7 Global Title processes. (MIN to MSC, MIN to HLR, IMSI to MSC, IMSI to HLR?)**

Enhanced translation has to be added to translate MIN to HLR. As pointed out earlier the STP should be capable of 10 digit translation for MIN to HLR.

**System Performance:**

**Identify any expected performance implications/impacts on: normal call processing, post dial delay, registration, authentication, roaming?**

Since there is a potential for a dialed directory number to be translated to location routing number, wireless number portability in general will increase the number of messages from the switching center to the STPs and LNP-SCP. Also, in this option (OPTION - 1), there is a need to have a 10 digit translation of MIN to HLR. This will have minor impact on the performance of the system.

**Normal Call Processing & Post Dial Delay:**

In case of call delivery to a ported mobile, there may be a small added delay (up to 300msec) due to LNP-SCP query to obtain the LRN. For call origination by a ported mobile at the visited MSC there may be an added delay to convert MIN to HLR address. These delays will not significantly affect the performance of the system.

**5.2 Network functionality:**

**5.2.1 Registration:**

**How should mobile registration be accomplished under number portability?**



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Under OPTION-1, we will use MIN for mobile registration. Since IMSI is not portable, IMSI is not considered as mobile identification under this option. Refer to Figure 1-2 for registration.

**Given that today we use the MIN which is currently the Mobile Directory Number (MDN) and that we have agreed to move to use of IMSI with the new digital technology, what process should be used to register mobiles under number portability?**

We have to keep MIN as one of the identifiers for registration as long as there are analog subscribers. IMSI could be used for digital technology for registration. As pointed out earlier, IMSI is not considered for this option.

**Now that the MDN (and consequently the MIN based on today's use) could be ported to from another provider including wireline, is there a solution to avoid changing the imbedded base of analog phones?**

As long as MIN is supported as the mobile identification, the analog phone base can be maintained. Under OPTION-1 since MIN will be ported there will be no need for reprogramming the MIN of the mobile.

**Could a process separating MIN and MDN be used?**

OPTION-1 does not separate MIN and DN. See OPTION-2 for a process which separates MIN and MDN.

**Could we use a process based on Mobile Station Identification (MSID) e.g. IMSI plus pseudo-IMSI for the MDN as MIN based phones?**



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Since existing analog mobiles do not support IMSI, usage of pseudo-IMSI for these mobiles will not provide any advantage. Also, the analog air interface does not support IMSI type of identification for these mobiles.

**Is there a solution that avoids ten digit Global Title Translation (GTT) for routing Mobile Application Part messages?**

The ten digit Global Title Translation is needed for translating MIN to HLR address under OPTION-1.

**What are the international implications?**

MIN supports international roaming based on agreement with international bodies (like IFAST). For point codes to directly transfer across most international boundaries E.212 IMSI type identification is needed. OPTION-1 does not support the use of IMSI.

**Describe the process flow and protocol implications. Describe the impacts on all network elements.**

The following diagram Figure 1-2 illustrates the registration process for OPTION-1.

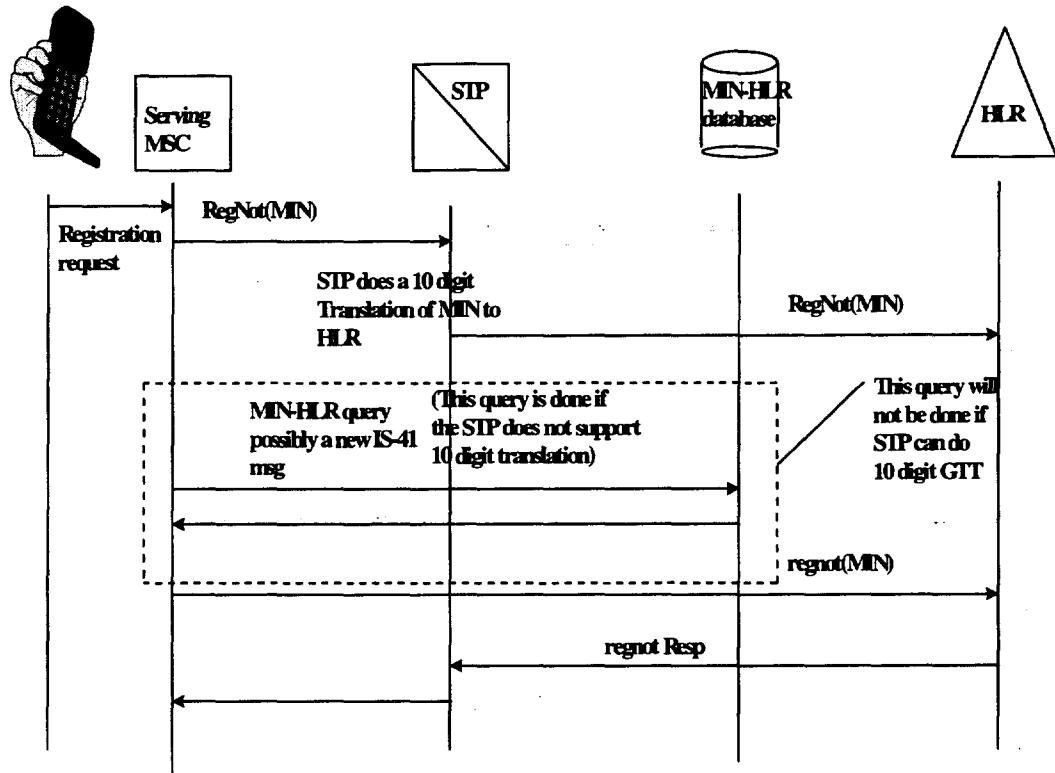


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Figure 1-2

## LNP - OPTION -1

### Mobile Registration Process Flow

**Registration:**

1. Upon power up the mobile sends the registration request to the serving MSC.
2. The serving MSC forwards the RegNot to the STP for a 10 digit translation of MIN to HLR. The STP forwards the RegNot message to the HLR of the mobile. If the STP does not support 10 digit translation of the MIN to HLR, the MSC has to send a query to get the HLR address of the mobile from MIN-HLR database. This query should



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preferably be an IS-41 message and possibly a new message. Upon receiving the HLR address the serving MSC sends the RegNot message to the HLR.

3. The HLR checks the MIN of the mobile for validity and authenticates the mobile. The HLR sends appropriate RegNot response back to the serving MSC through the STP.

### **5.2.2 Authentication:**

**How will authentication be supported in a service provider, number portability environment?**

The only impact under this option will be the identification of HLR/AC using the MIN. As long as we know the HLR/AC for the mobile, the authentication procedure itself will not be impacted in this option.

### **5.2.3 Call Handling:**

#### **5.2.3.1 Call Origination on MSC:**

**Can a determination be made that the call is to another mobile for potential services and call routing efficiencies?**

Since the LNP-SCP database could have both wireline and wireless numbers, the determination on whether a call is for a mobile can be done only if there is additional data stored in the LNP-SCP to indicate if a DN has subscription to wireline or wireless service provider.

**Will the MSC use the SS7 Call Completion to Portable Number network capability?**



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The basic assumption of this response is that wireless number portability will use LRN solution.

**How is the appropriate subscriber information - ANI (charge number) and calling party number correctly populated?**

Under OPTION-1 MIN and DN need not be separated. So there should not be any impact on providing ANI and calling party number.

**5.2.3.1.1 To Wireline:**

**What changes need to be made to allow the MSC to do the LNP query for a local call?**

The MSC will use the dialed number trigger to generate a query using the IS-41C OriginationRequest Message to do the LNP-SCP query.

**How will the MSC interact with the routing databases when defined?**

The MSC will query LNP-SCP database for call origination, if the number block is ported.

The following diagram Figure 1-3 provides the message flow for a basic mobile to landline call.

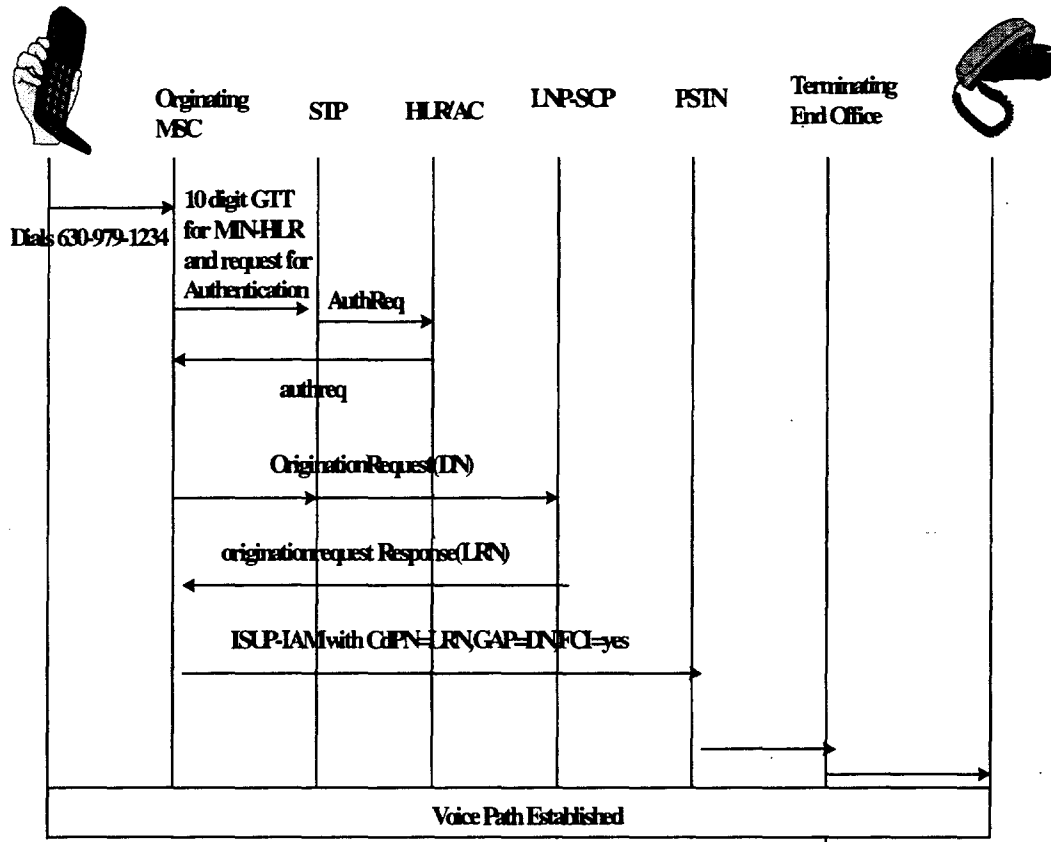




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Figure 1-3

# LNP - OPTION - 1 MOBILE-LAND CALL



## Mobile Call Origination: Mobile-Land Call:

1. Upon receiving the dialed number from the mobile, the serving MSC forwards the AuthReq message to the STP which does a 10 digit GTT to STP for mapping the HLR/AC address of the mobile based on its MIN.



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2. The STP forwards the necessary information for authentication to the HLR/AC of the mobile.
3. Upon receiving the origination authentication, if the dialed number belongs to ported block the serving MSC will send an OriginationRequest message to the LNP-SCP database.
4. The MSC will use the LRN returned in the LNP-SCP database query to route the call through the PSTN to the terminating end office. The MSC will use the ISUP IAM message with Cdpn = LRN, GAP=Dialed Digits and FCI=yes. The subsequent exchanges will not do the LNP-SCP database dip.
5. From the terminating end-office the call will be routed to the landline.

### **How is the call processed if the call is beyond the local area?**

In this proposal, a LNP-SCP query by the first possible switch is recommended. To avoid additional queries, it is preferable that the routing network be an ISUP network. Other than this requirement, the call processing for a local call and for Inter-LATA call will be the same.

### **What type of triggers are used?**

Dialed number trigger will be used to generate OriginationRequest message by the MSC to LNP-SCP. The LRN solution requires a database of ported NPA-NXX. The dialed number trigger will happen only if the number is in the ported number block.

### **What are the protocol impacts - IS-41, IS-652, etc?**



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The MSC should support IS-41C for supporting OriginationRequest message. The LNP-SCP should be capable of handling IS-41C query..

### **5.2.3.1.2 To Wireless**

**Are there efficiencies which can be developed for delivery to a wireless user or must the procedure be the same as for wireline delivery?**

The procedure will be similar with respect to LNP-SCP query between wireline and wireless.

**What are the protocol impacts and performance implications. Can efficiencies be implemented?**

As pointed out earlier, to avoid multiple LNP-SCP query, ISUP network is preferred. The system should support IS-41C standards.

**Can we avoid the trunking to the home location and then trunking to the visited location?**

Routing directly to the visited MSC for a roaming mobile can improve trunking efficiency. But this requires changes to the LNP-SCP for the support of the HLR address of the mobile. Also, if the originating exchange is a landline exchange it should be capable of communicating with the HLR to get the response for visited system address.

**How is the location request message routing handled? (e.g. GTT at STPs, GTT to HLR...)**

Since the LNP-SCP query will provide the address for the Home-MSC, the translation of DN to HLR could be accomplished with fewer digits. This translation can be done either



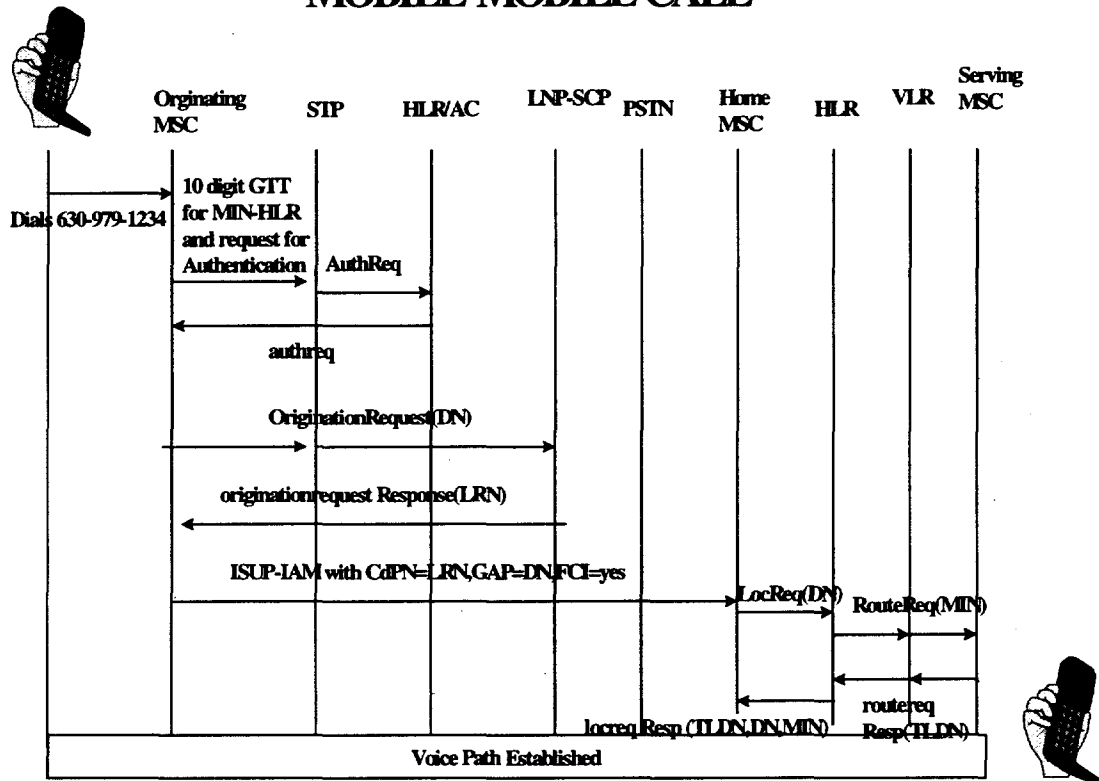
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at the Home-MSC itself or at the STP. The number of digits that is required for this translation depends on the how the HLRs are engineered.

The following diagram Figure 1-4 illustrates the call flow for a call to a wireless subscriber.

Figure 1-4

## LNP - OPTION - 1 MOBILE-MOBILE CALL



The call flow for a mobile to mobile under OPTION-1 is as follows:



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1. Upon receiving the dialed number from the mobile, the serving MSC forwards the AuthReq message to the STP which does a 10 digit GTT for mapping the HLR/AC address of the mobile based on its MIN.
2. The STP forwards the necessary information for authentication to the HLR/AC of the mobile.
3. Upon receiving the origination authentication, if the dialed number belongs to ported block the serving MSC will send an OriginationRequest message to the LNP-SCP database.
4. The originating MSC will route the call to the switch address based on the LRN provided by the LNP-SCP query. In this case, the switch will be the Home-MSC of the terminating number.
5. The Home-MSC shall map the dialed DN to HLR using either an internal table or an STP translation and send a Location Request message to the HLR.
6. The HLR will send a Route Request message to the VLR, if there is a VLR pointer for the mobile. The Route Request message will use the MIN as the parameter.
7. The VLR will respond to the HLR with route request Response message with TLDN as the parameter.
8. The HLR will respond to the Home-MSC with Location Request Response message with TLDN as a parameter.
9. The Home-MSC will set-up the voice path and terminate the call to mobile.



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**5.2.3.2 Call delivery to mobile station:**

**How will call delivery to a mobile station be accomplished?**

The LNP-SCP query will provide the LRN of the Home-MSC of the terminating mobile. The originating exchange will set-up the ISUP connection to the Home-MSC. The Home-MSC make an internal translation or an STP translation to identify the HLR of the terminating mobile using the dialed digits. The Home-MSC will launch a Location Request to the HLR and will route the call to the mobile upon receipt of the location request Response.

**Will a network routing number be assigned to each MSC?**

Yes. Each MSC will have a network routing number (LRN).

**If efficiencies are applied can we avoid triggering the LNP processes in routing to the termination location?**

The LNP-SCP query triggering can be avoided at the terminating location or multiple database dip can be avoided provided an ISUP connection is set-up. One query will be made unless the DN is not part of a ported block of numbers.

**How is location request message routing handled? (e.g. GTT at the STPs, GTT to HLR,...)**

Since the LNP-SCP query will provide the address for the Home-MSC, the translation of DN to HLR could be accomplished with fewer digits. This translation can be done either



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at the Home-MS-C itself or at the STP. The number of digits that is required for this translation depends on the how the HLRs are engineered.

### **5.3. Roaming Issues:**

#### **How will the roamer tables be handled with number portability?**

The Roamer Service List and Network Service List are used to either allow or deny call origination or call delivery to a non-registered roamer. These lists use NPA-NXX format for verifying the allowable roamers. Since under OPTION-1, both MIN and DN are portable, NPA-NXX form will not be sufficient. There is a need for unique service provider identification for these tables. The roamer table is also used to locate the HLR of the mobile. Under OPTION-1, since MIN and DN are ported, we need a 10 digit translation of MIN to HLR. The current practice of NPA-NXX type of roamer table will not be sufficient to get the HLR address.

#### **What are the implications to performance, protocols and architecture?**

There will no significant impact on the system performance. There will be some added delay due to the need to process the 10 digit translation of MIN to HLR for either registration or call delivery to roamers.

#### **How will roaming with Mexico and Canada be accomplished?**

The existing roaming scheme should work for roaming with Mexico and Canada. LNP-SCP query can be done by the gateway in the United States if no such databases are implemented in Canada or Mexico.



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**How would roaming with other countries using the same technology work?**

MIN supports international roaming only based on agreement by international bodies (like IFAST). A direct transfer across international boundaries is not possible with MIN.

MIN will be able to support international roaming as exists to-day under this option.

### **5.1. Database Issues:**

**What are the implications of databases to our network?**

Under OPTION-1, we need either a database for MIN to HLR translations or an STP capable of 10 digit GTT in addition to LNP database.

**What wireless information should be added to the currently proposed SMS and SCP databases?**

Any ported subscriber DN and the associated network address of the HOME-MSC (LRN) should be added to the LNP-SCP. In addition MIN to HLR translation has to be added to the database.

**Should wireless develop their own database for each HLR location?**

Since LNP data requires co-ordination with other service providers, it is recommended that this database be administered by a third party. MIN to HLR translation could be part of the LNP-SCP database. The only problem with this is that when subscriber data is moved from one HLR to another HLR even if it is within the jurisdiction of the same service provider, the LNP-SCP database has to be updated.

**Is the development of mobile station identification database an issue? Does it address administration?**





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Development of mobile identification database is not an issue. It is a simple relationship between the MIN and the network address of the HLR supporting the MIN. There is some additional administrative work involved in this database when some data is moved from one HLR to another HLR as pointed out in the previous response.

### **What are the implications of using another carrier's database or query process?**

Except the cost and administrative co-ordination considerations, there is no other implication in using other carrier's database for query process.

### **5.1. Mobile station identification Issues:**

#### **What should our long term identification method be?**

In the long term, to support international roaming we propose to use IMSI type of mobile identification. But this cannot be the only mobile identification method as long as we have analog mobile subscribers.

#### **Should we focus on IMSI as the identification?**

We could focus on IMSI for digital technology.

#### **Can we transition from MIN to IMSI gracefully?**

The wireless system software can transition from MIN to IMSI gracefully when IMSI is provided as the primary mobile identification method. But there will be a cost associated with moving the existing analog subscriber to digital technology. We need IS-41D to support full 15 digit E.212 IMSI. Also, international roaming issues are being addressed in IS-41D. North American IMSI translation type 9 has not been deployed. ITU does not have a MIN or E.212 translation type.



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### **Would it be possible to use a pseudo-IMSI based on MIN?**

Since the analog mobile terminal does not support 15 digits for mobile identification needed for IMSI, there will be minimal advantage in using pseudo-IMSI based on MIN.

### **Could a process separating MIN and MDN be used?**

Under OPTION-1, MIN and DN will be the same. See OPTION-2 for details on separating MIN and DN.

### **Can IMSI be used for other processes rather than MIN?**

IMSI could be used for international roaming besides being used for identifying HLR of the mobile.

## **5.1. Service Interactions:**

### **5.6.1 Over the Air Activation (OTA):**

#### **How will OTA work given the number portability?**

Current implementation of OTA calls for programming the MIN. Under OPTION-1 since we are porting the MIN and MIN is used as the primary identification there will be no impact on OTA.

#### **If we changed to IMSI, can an IMSI be changed via OTA if the customer changes providers or wants another provider upon activation?**

The NAM download under OTA provides ability to download IMSI. So if the standards specify that IMSI will be used as the primary mobile identification, OTA has the ability to program IMSI.



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### **5.6.2 Short message services:**

#### **How will short service operate under number portability?**

Under OPTION-1 since MIN and DN are the same, there will be no impact on short message service. The MIN to Message Center (MC) GTT will have to support 10 digits. MC will continue to identify the HLR based on MIN/MDN.

#### **Are there implications for short message service protocols?**

Under OPTION-1, there is no impact on short message service protocol.

### **5.6.3 Data Services:**

#### **How will data services operate under number portability?**

Data services will have the same impact as that of normal call delivery. Other than that there is no additional impact on data services due to number portability.

#### **Are there implications for the protocols?**

There is no impact on the protocols for data services due to number portability.

### **5.6.4 Emergency Services:**

#### **How will emergency services be impacted by number portability?**

The emergency services will have the same impact as that of normal call delivery.

#### **Can Enhanced-911 be supported in a service provider number portability environment? What are the impacts?**

Enhanced-911 can be supported under number portability. The impact will be same as normal call origination under number portability.



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**5.6.5 Operator Services:**

**What are the impacts on Operator Services?**

Under OPTION-1, there will be no impact on Operator services.

**5.6.6 Other impacts on existing services and Features**

**What are the impacts on IS-52 services, e.g. CLASS type services?**

There will be no impact on CLASS type services under OPTION-1.

**5.7 Operational Support Systems:**

**5.7.1 Service Management Systems(SMS):**

**Please identify any wireless requirements for the SMS. Also, identify any needed interface with the SMS or its databases. Please identify any unique needs of the wireless network over wireline.**

There should be provision to populate the MIN to HLR translations under OPTION-1. Otherwise, this option has the same impact on SMS as for use of the LRN in the wireline network.

**5.7.2 Billing:**

**Please identify the proposed methods for billing under number portability. What should the identifier be? How will call detail records change? What will be used for V and H coordinates?**

Under OPTION-1, since both MIN and DN are ported there should be a translation to provide the service provider identification. There may be a need for providing service provider identification under AMA records.



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### **5.7.3 Maintenance Systems:**

**How will existing maintenance systems be impacted by number portability and its proposed architecture, performance and protocol changes?**

As pointed out earlier, there is a need to maintain the LNP-SCP as well as the maintenance of MIN to HLR mapping. If a service provider uses another carrier's database instead of their own, they have to have agreement on database administration with the carrier. If a service provider plans to deploy their own LNP-SCP database, they should have agreement with other service providers for timely updates. They should have trained staff to trouble shoot problems in the database. They should have proper infrastructure set-up for trouble shooting.

### **5.7.4 Customer Care**

**How will our customer care systems interact with number portability impacts? (e.g. 611 routing) Will they interact with the SMS, other databases, billing systems effectively?**

### **5.8 Timing:**

Expect that sufficient time exists for the development of standards, and software development to meet the FCC deadlines.

## **6. Fraud Issues:**

### **6.1 Fraud Management:**



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**How will number portability impact fraud management systems? Can these systems interact with the new environment in real time? What are the performance impacts?**

Under OPTION-1, there will be no additional impact for fraud management systems. For authentication, there is a need to map MIN to HLR address.

### **6.2 LAES:**

**Are changes needed to support LAES requirements?**

There will be some impact as this feature requires provision of service provider identification.



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**III. Advantages and disadvantages with OPTION-1:**

1. Since MIN and DN are not separated, this option requires a 10 digit GTT of MIN to HLR at the STP (it requires administration of the translation also) or requires additional network element for MIN to HLR translation.
2. This option require administration of MIN to HLR database/translations.
3. This option does not require reprogramming of the mobile.
4. Since MIN is ported and IMSI is not ported, this option does not support IMSI as the mobile identification scheme.
5. MIN does not sufficient address space for country code needed for international roaming.



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**IV. Response: OPTION-2**

The section numbers provided in the CTIA RFI has been maintained in this document for easy reference.





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### **Section 5.1: Proposed Architecture overview:**

**OPTION-2: In this option the DN will be ported and MIN will NOT be ported.**

Refer to Figure 2-1, Figure 2-2, Figure 2-3, Figure 2-4 for an overview of this option.

In this option since MIN is not ported, it can provide unique identification and a 6 digit translation can be used for locating the HLR of a mobile. Since we need unique and non-portable identification for the mobile IMSI could be used as the mobile identification for mobiles employing the digital technology.

#### **Network elements:**

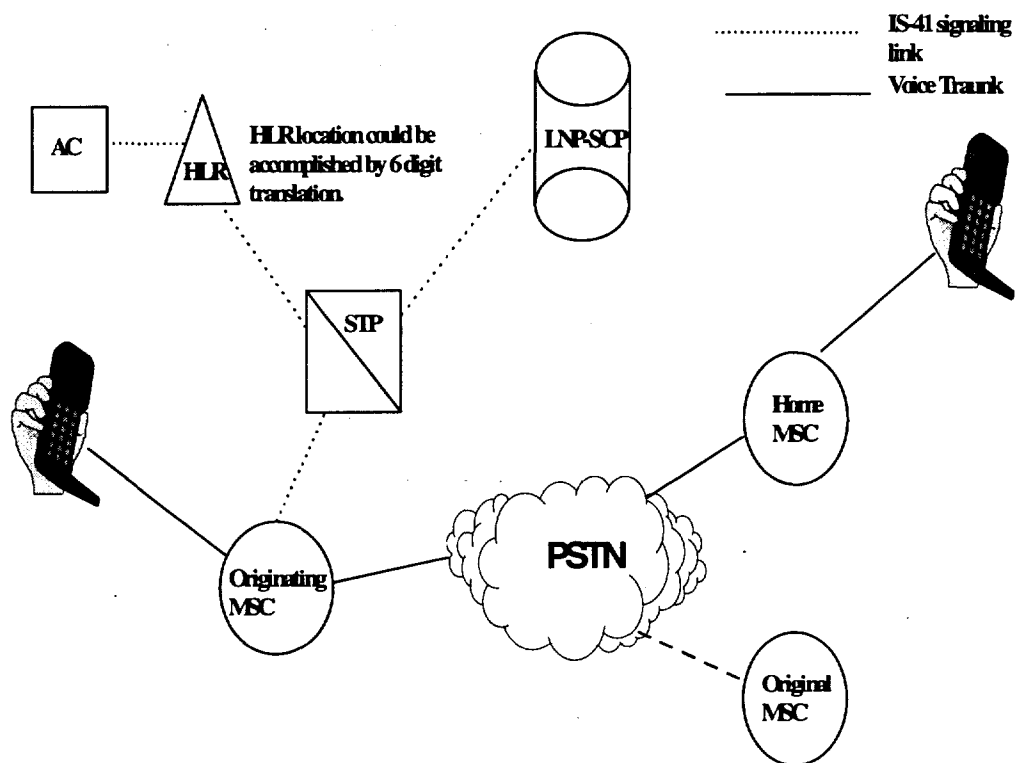
**Does the architecture use any one or a combination of the following: STP, SCP, ISCP, IP, MSC, etc. If so, what information and process needs to be available at each element? Is more than one database required?**

Beside the normal wireless network elements, this option requires just the LNP-SCP for mapping ported directory number to LRN. A standalone HLR is preferred as part of a WSCP. But the solution is applicable for both standalone HLR and integrated HLR. The network elements and their functionality is explained in the various call scenarios provided later. The basic elements of the network are provided in the following diagram Figure 2-1:



## LNP- OPTION-2

### BASIC NETWORK ELEMENTS



**Identify any trigger mechanisms and protocols used, and at which points in the network for this architecture? (ITU IN CS 1R, ANSI IN, AIN, WIN?)**

The existing IS-41C OriginationRequest message would be used to query LNP-SCP



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database for mapping the LRN with the dialed number. The LNP-SCP should be capable of supporting IS-41C query.

### **Gateway Requirements:**

**Are there requirements for a new gateway function for wireless networks?**

No new gateway functions for wireless networks is assumed in this response.

### **Network Routing Number Entity:**

**Under LRN process to which network element does the network routing number point? (MSC-Home, HLR, MSC-Gateway, Mobile network gateway)**

In this architecture, it is assumed that the LRN provided by the LNP-SCP database is the network address of the HOME-MSC.

### **Central database:**

**Is a central database for wireless use required for identification of HLRs or are there other methods available?**

No need to have a central database for the identification of HLR under this option.

Existing 6-digit translation of MIN to HLR is sufficient.

### **SS7 Global Titles:**

**Identify any impacts on current SS7 Global Title processes. (MIN to MSC, MIN to HLR, IMSI to MSC, IMSI to HLR?)**

Under OPTION-2, the existing 6 GTT for MIN to HLR or IMSI to HLR is sufficient to get the address of HLR. .

### **System Performance:**



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**Identify any expected performance implications/impacts on: normal call processing, post dial delay, registration, authentication, roaming?**

Since there is a potential for a dialed directory number to be translated to location routing number, wireless number portability in general will increase the number of messages from the switching center to the STPs and LNP-SCP. This may have a minor impact on the performance of the system.

### **Normal Call Processing & Post Dial Delay:**

In case of call delivery to a mobile, there may be a small added delay (up to 300msec) due to LNP-SCP query. (LNP-SCP query need not be made on every call if a database of ported DN blocks is maintained at the MSC) This delay will not significantly affect the performance of the system.

## **5.2 Network functionality:**

### **5.2.1 Registration:**

**How should mobile registration be accomplished under number portability?**

Under OPTION-2, we can use MIN or IMSI for mobile registration as is currently done. No changes in registration are required.

**Given that today we use the MIN which is currently the Mobile Directory Number (MDN) and that we have agreed to move to use of IMSI with the new digital technology, what process should be used to register mobiles under number portability?**



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We have to keep MIN as one of the identification for registration as long as there are analog subscribers. IMSI could be used for digital technology for registration.

**Now that the MDN (and consequently the MIN based on today's use) could be ported to from another provider including wireline, is there a solution to avoid changing the imbedded base of analog phones?**

As long as MIN is supported as identification, analog mobiles could be used in analog network. Under OPTION-2 since MIN/IMSI will NOT be ported there will be a need for programming the mobile with a new MIN/IMSI, when DN is ported.

**Could a process separating MIN and MDN be used?**

OPTION-2 requires separation of MIN and DN.

**Could we use a process based on Mobile Station Identification (MSID) e.g. IMSI plus pseudo-IMSI for the MDN as MIN based phones?**

Since existing analog mobiles do not support IMSI, usage of pseudo-IMSI for these mobiles will not provide any advantage. Also, air interface does not support IMSI type of identification for these mobiles.

**Is there a solution that avoids ten digit Global Title Translation (GTT) for routing Mobile Application Part messages?**

The ten digit Global Title Translation is not needed for translating MIN/IMSI to HLR address under OPTION-2. Existing 6 digit translation is sufficient for locating the HLR.

**What are the international implications?**



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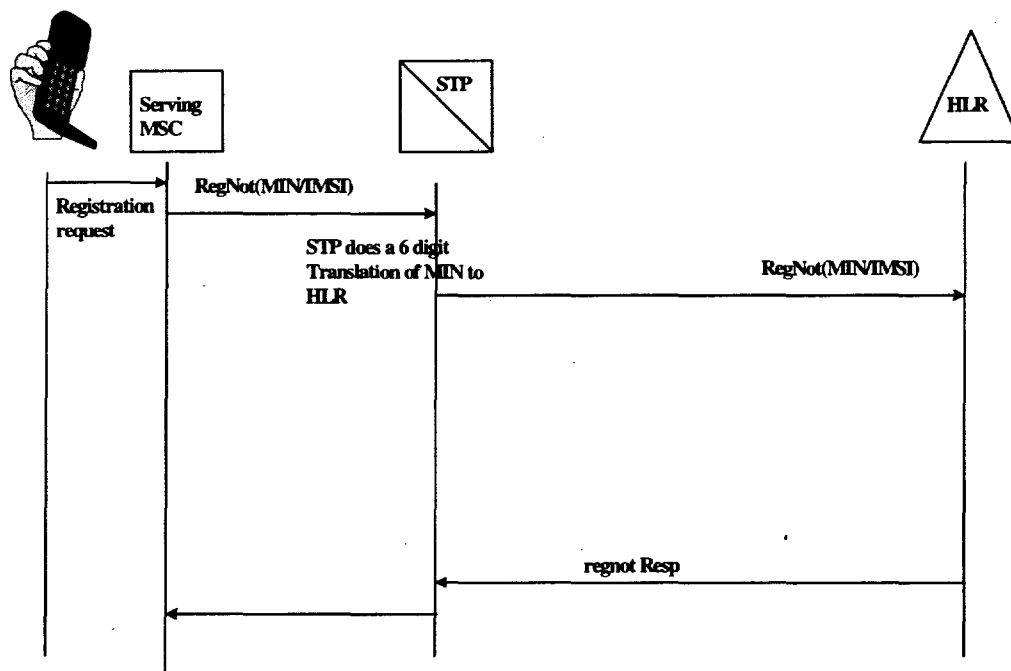
Existing international roaming capabilities using MINs can continue to be employed. If IMSI is used, as pointed out earlier, 15 digit E.212 IMSI support is available in IS-41D and the international roaming issues are addressed in IS-41D also. So the wireless network element should be at least IS-41D capable.

**Describe the process flow and protocol implications. Describe the impacts on all network elements.**

The following diagram Figure 2-2 illustrates the registration process for OPTION-2.

Figure 2-2

**LNP - OPTION -2**  
**Mobile Registration Process Flow**



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### **Registration:**

1. Upon power up the mobile sends the registration request to the serving MSC.
2. The serving MSC sends the RegNot message to the HLR of the mobile through STP through the existing MIN/IMSI mapping functions.
3. The HLR checks the MIN of the mobile for validity of the mobile. The HLR sends appropriate RegNot response back to the serving MSC through the STP.

### **5.2.2 Authentication:**

**How will authentication be supported in a service provider, number portability environment?**

IS-41C standard uses MIN for authentication. So MIN will be used as the key for authentication. Locating HLR/AC can accomplished using 6 digit translation of the MIN/IMSI. Currently MIN is being used as a key for authentication and it has the same format as DN, DN should be the key for authentication.

### **5.2.3 Call Handling:**

#### **5.2.3.1 Call Origination on MSC:**

**Can a determination be made that the call is to another mobile for potential services and call routing efficiencies?**

Since the LNP-SCP database could have both wireline and wireless numbers, the determination on whether a call is for a mobile can be done only if there is additional data stored in the LNP-SCP to indicate if a DN has subscription to wireline or wireless service provider.



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**Will the MSC use the SS7 Call Completion to Portable Number network capability?**

The basic assumption of this response is that wireless number portability will use LRN solution.

**How is the appropriate subscriber information - ANI (charge number) and calling party number correctly populated?**

Under OPTION-2 MIN and DN are separated. So for charging number and calling party number the DN has to be populated.

### **5.2.3.1.1 To Wireline:**

**What changes need to be made to allow the MSC to do the LNP query for a local call?**

The MSC will use the dialed number trigger to generate a query using the IS-41C OriginationRequest Message to the LNP-SCP.

**How will the MSC interact with the routing databases when defined?**

The following diagram Figure 2 - 3 provides the message for basic mobile to landline call.

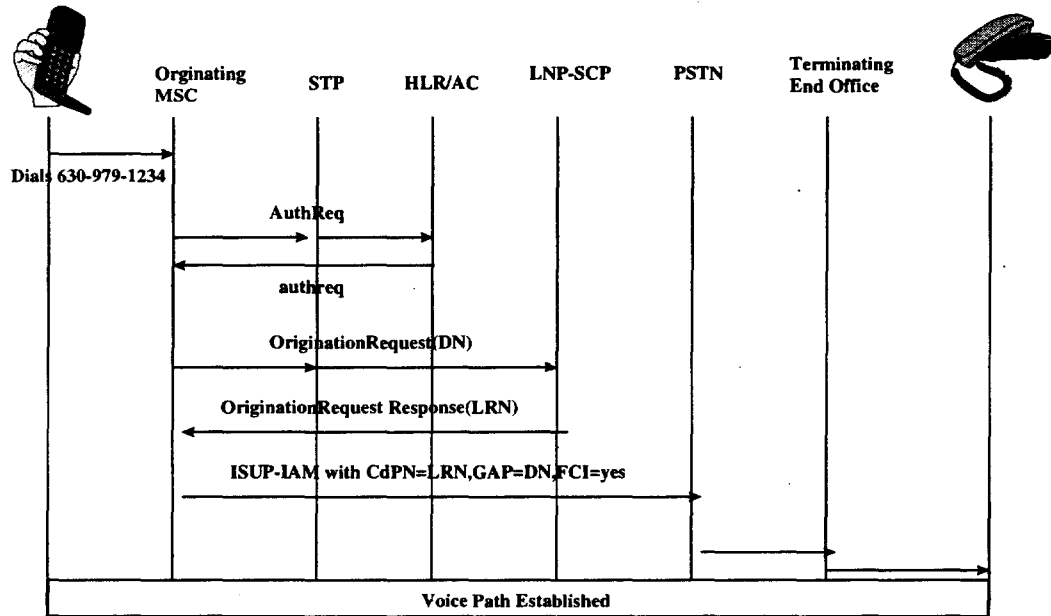




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Figure 2-3

## LNP - OPTION - 2 MOBILE-LAND CALL



### Mobile Call Origination: Mobile-Land Call:

1. Upon receiving the dialed number from the mobile, the serving MSC sends necessary information for authentication to the HLR/AC of the mobile using the existing procedure.
2. Upon receiving the origination authentication, if the dialed number belongs to ported block the serving MSC will send an OriginationRequest message to the LNP-SCP database.
3. The MSC will use the LRN returned in the LNP-SCP database query to route the call through the PSTN to the terminating end office. The MSC will use the ISUP IAM



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message with CdPN = LRN, GAP=Dialed Digits and FCI=yes. The subsequent exchanges will not do the LNP-SCP database dip.

4. From the terminating end-office the call will be routed to the landline.

**How is the call processed if the call is beyond the local area?**

In this proposal, LNP-SCP query by the first possible switch is recommended. To avoid additional queries it is preferable that the routing network be an ISUP network. Other than this requirement, the call processing for a local call and for Inter-LATA call will be the same.

**What type of triggers are used?**

The Dialed number trigger will be used to generate IS-41C OriginationRequest message by the MSC to LNP-SCP.

**What are the protocol impacts - IS-41, IS-652, etc?**

The MSC should support IS-41C . The LNP-SCP must also support IS-41C.

**5.2.3.1.2 To Wireless**

**Are there efficiencies which can be developed for delivery to a wireless user or must the procedure be the same as for wireline delivery?**

The procedure will be similar with respect to LNP-SCP query between wireline and wireless.

**What are the protocol impacts and performance implications. Can efficiencies be implemented?**



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As pointed out earlier, to avoid multiple LNP-SCP query, ISUP network is preferred. The MSC and LNP-SCP should support IS-41C standards.

**Can we avoid the trunking to the home location and then trunking to the visited location?**

Routing directly to the visited MSC for a roaming mobile can improve trunking efficiency. But this requires changes to the LNP-SCP for the support of the HLR address of the mobile. Also, if the originating exchange is a landline exchange it should be capable of communicating with the HLR to get the response for visited system address.

**How is the location request message routing handled? (e.g. GTT at STPs, GTT to HLR...)**

Since the LNP-SCP query will provide the address for the Home-MSC, the translation of DN to HLR could be accomplished with current procedures. This translation can be done either at the Home-MSC itself or at the STP. The number of digits that is required for this translation depends on the how the HLRs are engineered.

The following diagram Figure 2-4 illustrates the call flow for a call to a wireless subscriber.

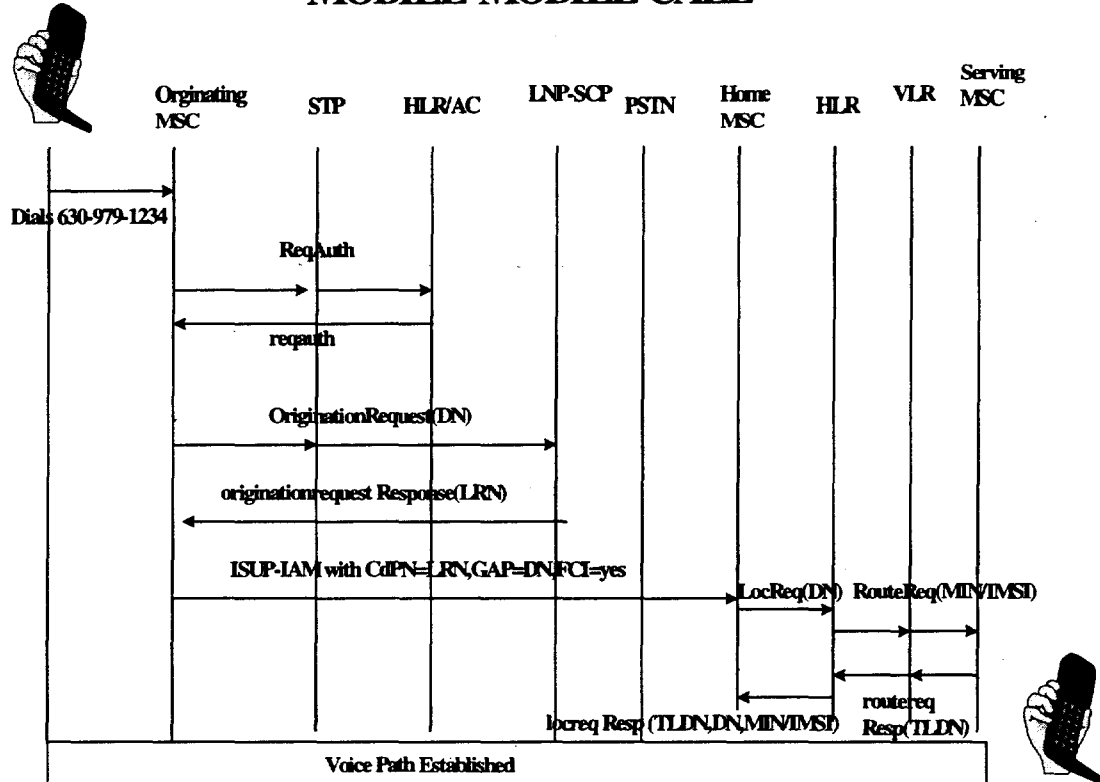


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Figure 2-4

## LNP - OPTION - 2

### MOBILE-MOBILE CALL



The call flow for a mobile to mobile under OPTION-2 is as follows:

1. Upon receiving the dialed number from the mobile, the serving MSC sends the necessary information for authentication to the HLR/AC of the mobile.
2. Upon receiving the origination authentication, if the dialed number belongs to ported block the serving MSC will send an IS-41C OriginationRequest message to the LNP-SCP database.



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3. The originating MSC will route the call to the switch address based on the LRN provided by the LNP-SCP query. In this case, the switch will be the Home-MSC of the terminating number.
4. The Home-MSC shall map the dialed DN to HLR using either an internal table or an STP translation and sends a Location Request message to the HLR. (This is done according to the existing procedure. There is no change required for LNP).
5. The HLR will send a Route Request message to the VLR, if there is a VLR pointer for the mobile. The Route Request message will use the MIN as the parameter.
6. The VLR will respond to the HLR with Route Request Response message with TLDN as the parameter.
7. The HLR will respond to the Home-MSC with Location Request Response message with TLDN as a parameter.
8. The Home-MSC will set-up the voice path and terminate the call to mobile.

**5.2.3.2 Call delivery to mobile station:**

**How will call delivery to a mobile station be accomplished?**

The LNP-SCP query will provide the LRN to the Home-MSC of the terminating mobile. The originating exchange will set-up the ISUP connection to the Home-MSC. The Home-MSC makes an internal translation or an STP GTT to identify the HLR of the terminating mobile using the dialed digits. The Home-MSC will launch a Location Request to the



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HLR and will route the call to the mobile upon receipt of the Location Request Response.

**Will a network routing number be assigned to each MSC?**

Yes. Each MSC will have a network routing number (LRN).

**If efficiencies are applied can we avoid triggering the LNP processes in routing to the termination location?**

An LNP-SCP query may not be necessary if the called number is not part of ported number block. Otherwise an LNP-SCP query is required.

The LNP-SCP query triggering can be avoided at the terminating location or multiple database dip can avoided provided an ISUP network is available. Multiple database dip could be avoided, if the intermediate exchange can identify that they are not the originating switch for a call and the originating switch made the database dip.

**How is location request message routing handled? (e.g. GTT at the STPs, GTT to HLR,...)**

Since the LNP-SCP query will provide the address for the Home-MSC, the translation of DN to HLR could be accomplished using existing procedure. This translation can be done either at the Home-MSC itself or at the STP. The number of digits that is required for this translation depends on the how the HLRs are engineered.

**5.3. Roaming Issues:**

**How will the roamer tables be handled with number portability?**



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The Roamer Service List and Network Service List used for verifying allowable roamers for a system should be modified to include service provider identification. In the case of IMSI, may be the Mobile Network Code could be used in these tables to indicate allowable roamers. In the case of MIN, there is a need for service provider identification. The roaming table is also used to locate the HLR of the mobile. Under OPTION-2, since MIN/IMSI and DN are separated and MIN is not ported, the HLR could be located using a 6 digit translation of the MIN/IMSI.

### **What are the implications to performance, protocols and architecture?**

There will be no additional impact on performance for OPTION-2.

### **How will roaming with Mexico and Canada be accomplished?**

The existing roaming scheme should work for MIN based mobiles for roaming with Mexico and Canada (based on IFAST agreement). There needs to be an agreement on the assignment of MIN as it will be separated from DN. For digital mobiles, IMSI can provide the capability of international roaming.

### **How would roaming with other countries using the same technology work?**

The MIN supports international roaming based on agreement with international bodies (like IFAST). Since MIN and DN are separated under this option, there is a need for coordination and assignment of MIN for international roaming agreements. As pointed out in the previous response, digital technology can use IMSI to support roaming with other countries with the same technology.

### **5.1. Database Issues:**



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### **What are the implications of databases to our network?**

Under OPTION-2, we need LNP-SCP database for translating dialed number to LRN. For OPTION-2 there are no additional databases needed.

### **What wireless information should be added to the currently proposed SMS and SCP databases?**

Any ported subscriber DN and the associated network address of the HOME-MSC (LRN) should be added to the LNP-SCP. If we want to identify that the call delivery is for a mobile subscriber, an indication can be added in the LNP-SCP for mobile subscribers.

### **Should wireless develop their own database for each HLR location?**

Since LNP data requires co-ordination with other service providers, it is recommended that this database be administered by a third party.

### **Is the development of mobile station identification database an issue? Does it address administration?**

Development of mobile station identification database is not an issue under this option as the MIN/IMSI will be unique and will not be ported.

### **What are the implications of using another carrier's database or query process?**

Except for the cost and administrative co-ordination considerations, there is no other implication in using other carrier's database for query process.

### **5.1. Mobile station identification Issues:**

#### **What should our long term identification method be?**





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In the long term, to support international roaming we propose to use E.212 IMSI type of mobile identification. But this cannot be the only mobile identification method as long as we have analog mobile subscribers. Till the analog system becomes obsolete, we need both MIN and IMSI as identification.

### **Should we focus on IMSI as the identification?**

We can focus on IMSI for digital technology.

### **Can we transition from MIN to IMSI gracefully?**

Yes. Since most of the messages support both MIN and IMSI, transition will be graceful. Till IMSI is made as the primary mobile identification number, the software has to handle both MIN and IMSI.

### **Would it be possible to use a pseudo-IMSI based on MIN?**

Since the analog mobile terminal does not support 15 digits for mobile identification needed for IMSI, there will be minimal advantage in using pseudo-IMSI based on MIN.

### **Could a process separating MIN and MDN be used?**

Under OPTION-2, MIN and DN will be the separated.

### **Can IMSI be used for other processes rather than MIN?**

IMSI could be used for international roaming besides being used for identifying HLR of the mobile.

## **5.1. Service Interactions:**

### **5.6.1 Over the Air Activation (OTA):**



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### **How will OTA work given the number portability?**

The standards allow for programming MIN as well as IMSI. So OTA will not be impacted by this option of number portability.

### **If we changed to IMSI, can an IMSI be changed via OTA if the customer changes providers or wants another provider upon activation?**

The NAM download under OTA provides ability to download IMSI. So if the standards specify that IMSI will be used as the primary mobile identification, OTA has the ability to program the IMSI.

### **5.6.2 Short message services:**

#### **How will short service operate under number portability?**

Under OPTION-2 since MIN and DN are separated, there will be minor impact on short message service. The impact involves the administration of data/translation at the message center. The message center data should have the both MIN and DN of the mobile to deliver the call.

#### **Are there implications for short message service protocols?**

Under OPTION-2, there is no impact of short message service protocol.

### **5.6.3 Data Services:**

#### **How will data services operate under number portability?**

Data services will have the same impact as that of normal call delivery. Other than that there is no additional impact on data services due to number portability.

#### **Are there implications for the protocols?**



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There is no impact on the protocols for data services due to number portability.

### **5.6.4 Emergency Services:**

**How will emergency services be impacted by number portability?**

The emergency services will have the same impact as that of normal call delivery.

**Can Enhanced-911 be supported in a service provider number portability environment? What are the impacts?**

Enhanced-911 can be supported under number portability. The impact will be same as normal call origination under number portability.

### **5.6.5 Operator Services:**

**What are the impacts on Operator Services?**

Under OPTION-2, no additional impact is expected.

### **5.6.6 Other impacts on existing services and Features**

**What are the impacts on IS-52 services, e.g. CLASS type services?**

Since DN will be used for CLASS, no additional impact is expected.

## **5.7 Operational Support Systems:**

### **5.7.1 Service Management Systems(SMS):**

**Please identify any wireless requirements for the SMS. Also, identify any needed interface with the SMS or its databases. Please identify any unique needs of the wireless network over wireline.**



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No additional needs are anticipated.

### **5.7.2 Billing:**

**Please identify the proposed methods for billing under number portability. What should the identifier be? How will call detail records change? What will be used for V and H coordinates?**

Since MIN and DN are separated, the billing records should have service provider identification. This can be accomplished by storing MIN besides DN in the billing records.

### **5.7.3 Maintenance Systems:**

**How will existing maintenance systems be impacted by number portability and its proposed architecture, performance and protocol changes?**

As pointed out earlier, there is a need to maintain the LNP-SCP. Since OPTION-2 requires separation of MIN and DN, MIN has to be administered by a third party. If a service provider uses another carrier's database instead of their own, they have to have agreement on database administration with the carrier. If a service provider plans to deploy their own LNP-SCP database, they should have agreement with other service providers for timely updates. They should have trained staff to trouble shoot problems in the database. They should have proper infrastructure set-up for trouble shooting.

### **5.7.4 Customer Care**



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**How will our customer care systems interact with number portability impacts? (e.g. 611 routing) Will they interact with the SMS, other databases, billing systems effectively?**

### **5.8 Timing:**

Expect that sufficient time exists for the development of standards, and software development to meet the FCC deadlines. In order to support E.212 IMSI for digital technology, we need IS-41D standards available.

### **6. Fraud Issues:**

#### **6.1 Fraud Management:**

**How will number portability impact fraud management systems? Can these systems interact with the new environment in real time? What are the performance impacts?**

Under OPTION-2, there is some impact for fraud management systems. The exact impact requires further investigation.

#### **6.2 LAES:**

**Are changes needed to support LAES requirements?**

There will be some impact as there is a need to provide service provider identification for this feature.



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### **V. Advantages and disadvantages with OPTION-2:**

- 1. Does not require 10 digit GTT of MIN to HLR at the STP.**
- 2. Requires mobile to be reprogrammed whenever a subscriber changes service provider.**
- 3. This option requires administration of MIN. There is a need for co-ordination and assignment of MINs.**
- 4. Since MIN is not ported, this option supports E.212 IMSI as identification for digital technology.**
- 5. IMSI will be useful for roaming in other countries of same technology.**
- 6. This option fully supports analog mobiles.**

### **VI. OPEN ISSUES:**

- 1. Need an industry-wide agreement on:**
  - whether to port the MIN or not,**
  - which identification scheme should be used MIN or IMSI or both,**
  - who will administer the MIN in the case that the MIN is not ported.**
  - if MIN is not ported, the MIN assignments has to be coordinated through an international body to facilitate international roaming.**



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2. If both the options presented in this response are implemented (i.e some carriers choose OPTION-1 and some carriers choose OPTION-2), there will be following consequences:

- Subscribers from OPTION-2 carriers will be able to roam into any system of the same technology. They will be “Universal Roamers”.
- Subscribers from OPTION-1 will not be able to roam to system using OPTION-2 as the MIN to HLR translation (10 digit GTT) will not be supported.
- Carriers using OPTION-1 will be “Universal roamer recipients”, whereas carriers using OPTION-2 will not be able to register subscribers from system using OPTION-1.
- Therefore, unless we have a single solution, we need to implement both the methods to meet the FCC’s requirement on wireless number portability with full roaming capability.



**MASTER COPY****VII. Glossary of Terms**

<b>Acronym</b>	<b>Expansion</b>
AC	Authentication Center
AMA	Automatic Message Accounting
AuthReq	Authentication Request
CdPA	Called Party Address
CdPN	Called Party Number
CLASS	Custom Local Area Signaling Services
CgPA	Calling Party Address
CgPN	Calling Party Number
CTIA	Cellular Telecommunications Industry Association
DN	Directory Number
EOs	End Offices
FCC	Federal Communications Commission
FCI	Forward Call Indicator
GAP	Generic Address Parameter
GTT	Global Title Translation
HLR	Home Location Register
IAM	Initial Address Message
IMSI	International Mobile Station Identifier (E.212)
IS-41C	Interim Standard - 41 Signaling Protocol for cellular Mobility Management- Revision C
IS-41D	Interim Standard - 41 Signaling Protocol for cellular Mobility Management- Revision D
LAES	Lawfully Authorized Electronic Surveillance
LATA	Local Access Transport Area
LNP-SCP	Local Number Portability - Service Control Point
LocReq	Location Request
LRN	Location Routing Number
MAP	Mobile Application Part
MDN	Mobile Directory Number
MIN	Mobile Identification Number
MS	Mobile Station
MSC	Mobile Switching Center
MSID	Mobile Station Identifier
OTA	Over the Air Activation
PSTN	Public Switched Telecommunications Network
RegNot	Registration Notification





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<b>Acronym</b>	<b>Expansion</b>
RFI	Request For Information
SCPs	Service Control Points
SMS	Short Message Service
SMS	Service Management System
SS7	Signaling System 7
STP	Signal Transfer Point
TLDN	Temporary Local Directory Number
VLR	Visiting Location Register

